



Industry Guide

Welding

Welding is a generic name referring to the process of joining pieces of metal using heat, pressure, or both. It is estimated that there are over 185,000 welders in the United States and another 700,000 workers who do some form of welding in their jobs.⁽¹⁾ The American Welding Society lists 80 different types of welding processes in current use. The health and safety hazards vary somewhat on the process being used and the metals involved. Those hazards may include:

Chemical agents

└ such as ozone, nitrogen dioxide, carbon monoxide, and metal fumes

Physical agents

└ such as ultraviolet radiation and noise

This publication is designed to assist health and safety professionals in choosing the appropriate equipment and methodology to assess the major chemical agents found in welding operations. Sources of additional information are described below.

The American Welding Society (AWS) at 800-443-9353 or www.aws.org offers publications on health and safety hazards in welding operations.

The National Institute for Occupational Safety and Health (NIOSH) offers a free publication on welding, brazing, and thermal cutting. Fax 513-533-8573 or e-mail pub-staff@cdc.gov and request Publication 88-110 or 88-110a (abridged version).

SKC Inc. at 724-941-9701 or www.skcinc.com offers equipment to evaluate noise.

Ozone and Nitrogen Dioxide

Ozone and nitrogen dioxide are produced by the action of ultraviolet light from the welding arc on the surrounding air.

Ozone and nitrogen dioxide are present in higher concentrations in gas metal arc welding, gas tungsten arc welding, and plasma arc cutting. Even greater quantities of nitrogen dioxide are formed if nitrogen is used as the shielding gas.

Ozone levels are higher when welding on aluminum and when using argon as the shielding gas.⁽¹⁾ Both compounds are irritating to the eyes, nose, and throat.

Very high exposures can cause fluid in the lungs and other long-term pulmonary illness.

The U.S. Occupational Safety and Health Administration (OSHA) regulates ozone as an eight-hour time-weighted average (TWA) of 0.1 ppm and nitrogen dioxide as a Ceiling of 5 ppm.

For details on these compounds, reference the following SKC Publications:

Ozone

Using Detector Tubes
Request SKC Detector Tube Brochure

Chemical Fact Files®

Nitrogen Dioxide

By OSHA Method ID 182
SKC Publication 1406

Nitric Oxide and Nitrogen Dioxide

By NIOSH 6014
SKC Publication 1390

SKC also offers a passive sampler validated for nitrogen dioxide air sampling. See www.skcinc.com. Nitrogen Dioxide Passive Sampler Cat. No. 500-200

Carbon Monoxide

Carbon monoxide is an odorless, colorless gas that can be formed by the burning or incomplete combustion of the electrode covering or flux and in the use of carbon dioxide as a shielding gas. Carbon monoxide can cause asphyxiation by interfering with the oxygen-carrying capacity of blood. OSHA established an eight-hour Permissible Exposure Limit (PEL) of 50 ppm for carbon monoxide. In typical welding operations, carbon monoxide concentrations are not high enough

to cause concern. However, workers can be exposed to high levels of carbon monoxide when welding in confined spaces.

For details on sampling carbon monoxide by OSHA ID 209 using a direct-reading instrument, ask for information on SKC equipment: Pac III Datalogging Instrument Cat. No. 805-30011 with software kit Cat. No. 805-300PAC and a carbon monoxide sensor.

Metal Fumes

Fumes are very small particles that are formed when metal is vaporized and then condenses. Metal fumes produced during welding are typically too small to be seen by the naked eye, but they can agglomerate to form visible particles. The chemical makeup of the fume will be determined by the base metal, coatings on the base metal, the filler metal, the electrode, and the flux.

Metal fume fever is a common temporary illness among workers exposed to the fumes of zinc when welding on galvanized surfaces, as well as from exposure to other metals such as copper, manganese, and iron.⁽²⁾ New workers and those returning to work after a weekend are more likely to experience the symptoms of nausea, headache, fever, and chills associated with exposure.

The major component of the fume generated from welding on steel is iron oxide. Iron oxide fume may cause some irritation of the nose and throat, and long-term exposure may cause deposition in the lungs called siderosis. However, no serious impairment of lung function is caused from exposure to this compound. More serious health effects may occur from exposure to nickel or chromium when welding on stainless steel or from cadmium when welding on cadmium-plated metals or cadmium-containing alloys.

NIOSH considers welding fumes to be a potential carcinogen and recommends the lowest feasible concentration be achieved. OSHA has PELs for individual metals.

For details on sampling metal fumes according to government methods, reference the following SKC publication:

Chemical Fact File

Welding Fumes (Metal and Metalloid Particulates)

by OSHA ID 125
SKC Publication 1371

References

- (1) Jeanne Mager Stellman, *Encyclopedia of Occupational Health and Safety*, 4th Ed., Vol III, International Labor Organization, Geneva, 1998, pp 78.2-78.30
- (2) William A. Burgess, *Recognition of Health Hazards in Industry: A Review of Materials and Processes*, 2nd Ed., John Wiley & Sons, New York, 1995, pp 303-317

Notice: This publication is intended for general information only and should not be used as a substitute for reviewing applicable government regulations, equipment operating instructions, or legal standards. The information contained in this document should not be construed as legal advice or opinion nor as a final authority on legal or regulatory procedures.